

LA-UR-00-3150

*Approved for public release;
distribution is unlimited.*

Title: **The Science of Diversity: How Diversity Enables Organizations**

Author(s): Norman L. Johnson,T-3

Submitted to: Diversity Office for Public distribution
Viewgraphs and text of the presentation at the Diversity Stand Down

Los Alamos

NATIONAL LABORATORY

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the University of California for the U.S. Department of Energy under contract W-7405-ENG-36. By acceptance of this article, the publisher recognizes that the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

Science of Diversity

How Diversity Enables Organizations

Norman L. Johnson

NORMAN@LANL.GOV

Theoretical Division

[http:// ishi.lanl.gov](http://ishi.lanl.gov)

Diversity - As the morally right thing to do

My view, for a long time, was that supporting diversity was is morally the right thing to do

And I naively assumed it was the same as affirmative action.

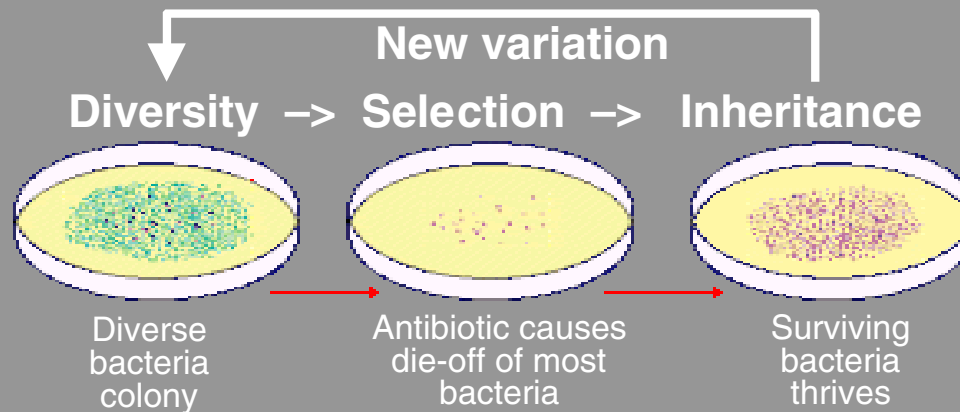
It is difficult to think back to those times, but I believe the problem was that I viewed the world as a competitive.

Where did that come from?

I think it's because the idea of natural selection - or survival of the fittest – dominates our view of the world.

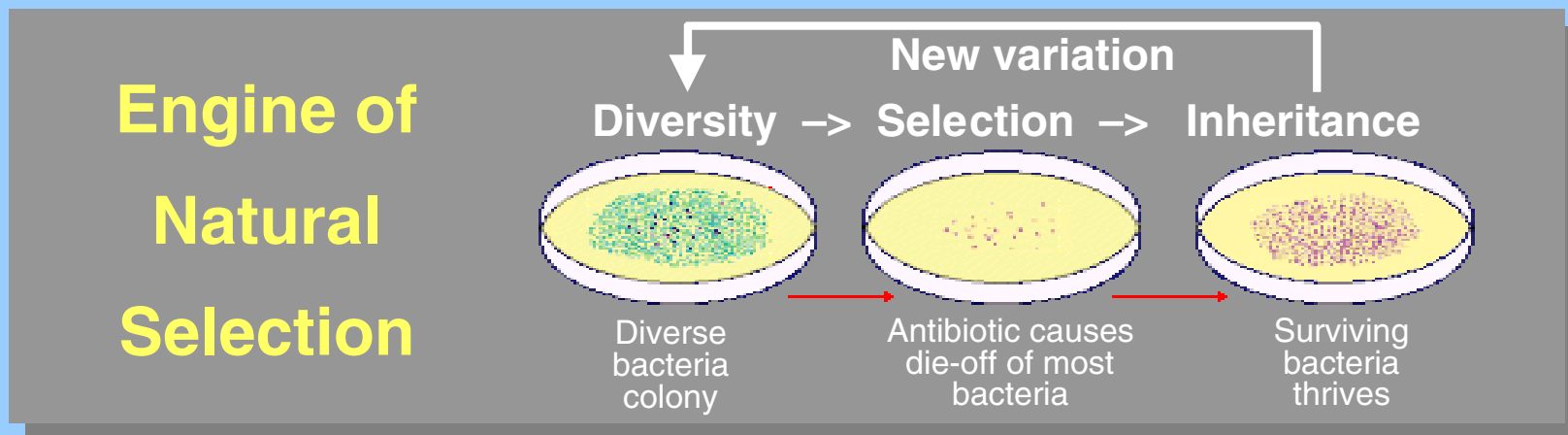
From the Viewpoint of Natural Selection

Engine of Natural Selection



From the Viewpoint of Natural Selection

Higher performance results from selection
which reduces diversity.

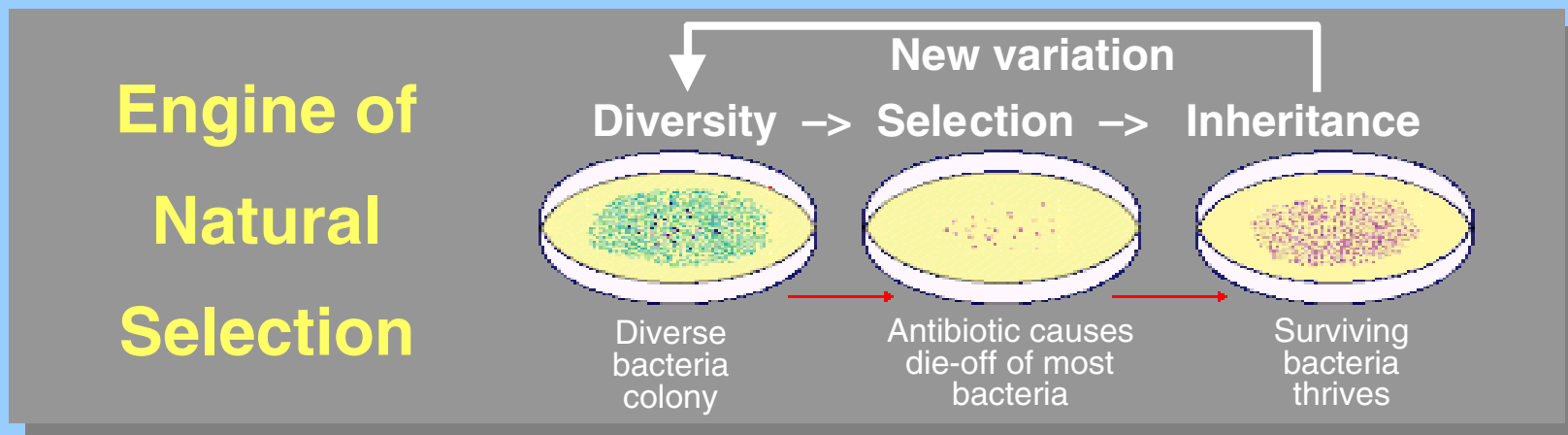


From the Viewpoint of Natural Selection

Higher performance results from selection
which reduces diversity.

Diversity lowers the global performance

*Lower performance of unfit individuals
leads to lower average population performance*



I was asked to “Make it Personal”

Why am I here today?

What made me become an advocate for Diversity?
Especially since I’m:

I was asked to “Make it Personal”

Why am I here today?

What made me become an advocate for Diversity?

Especially since I’m:

White - Northern European

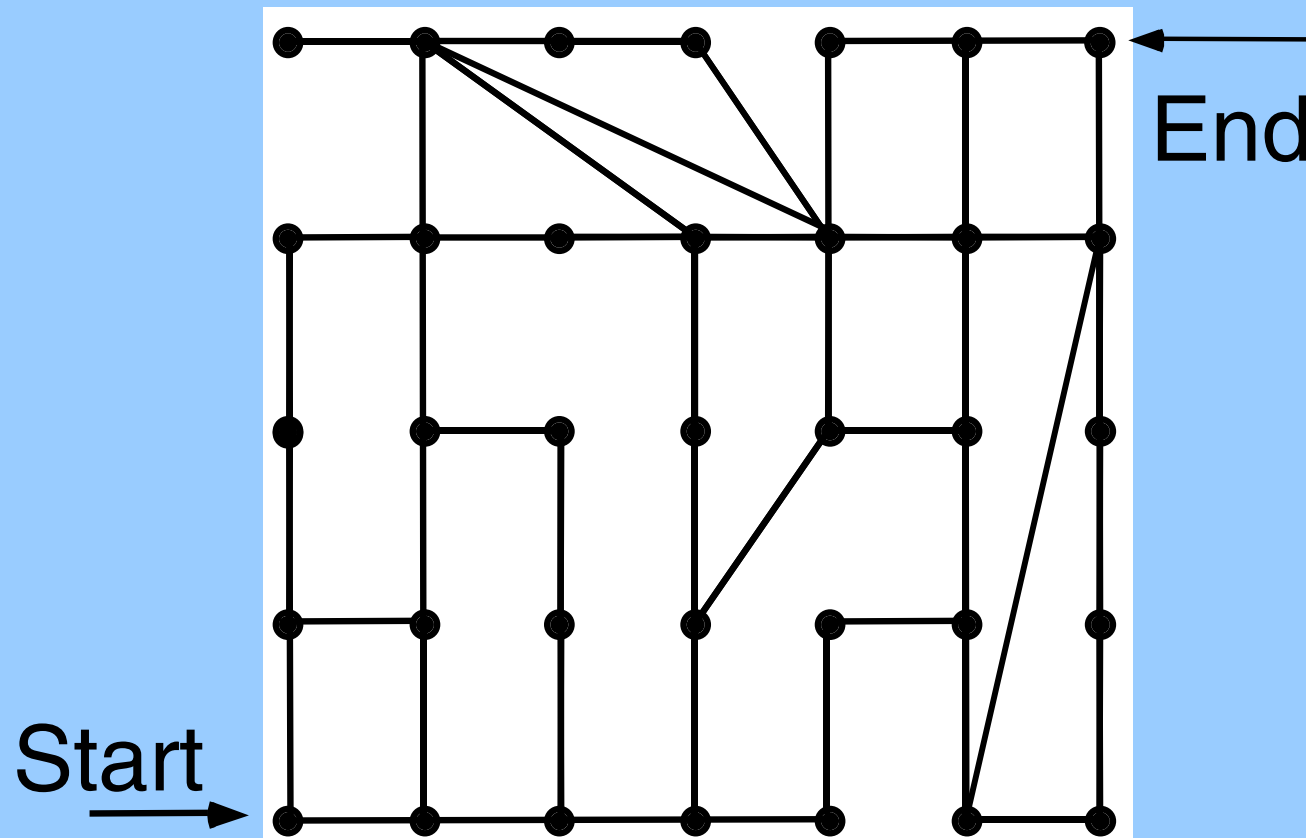
Male

Q- Cleared

Ph.D.

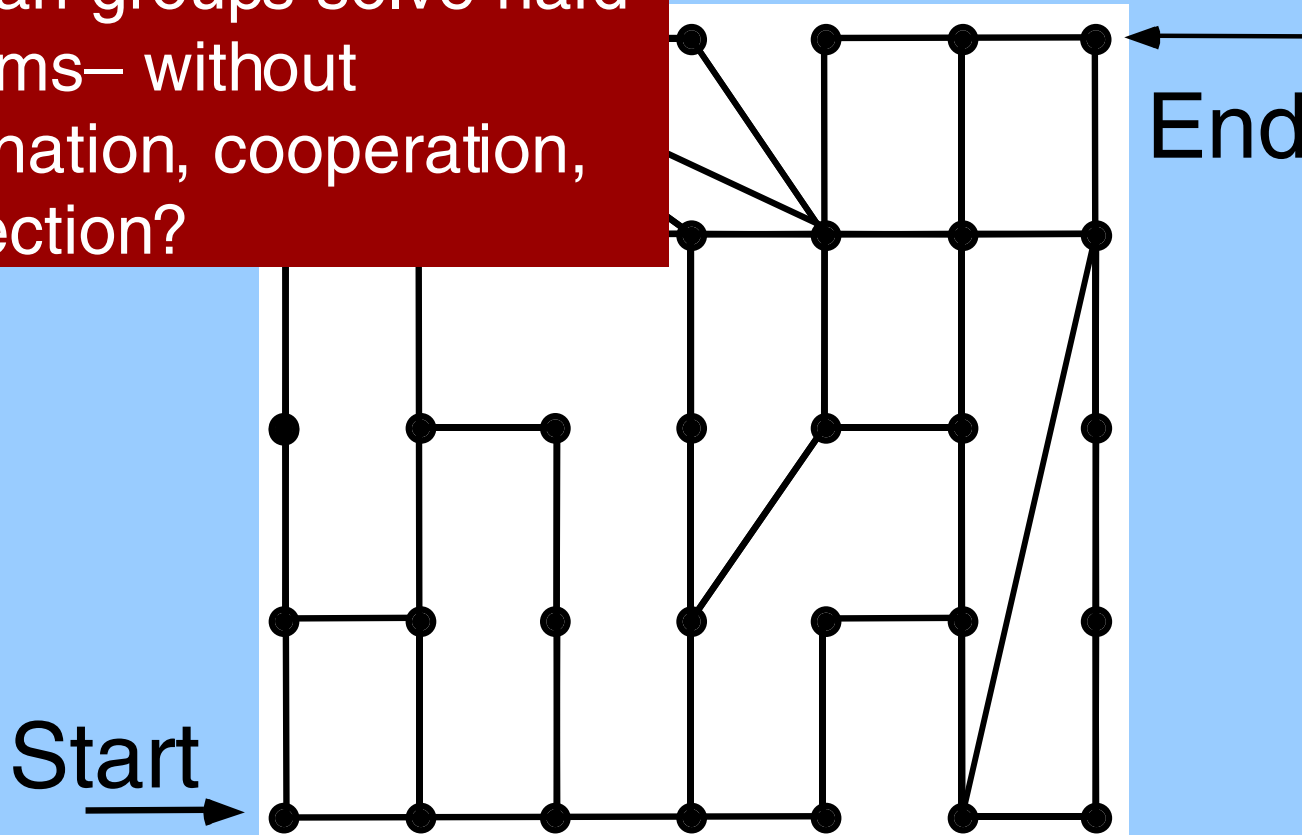
US born

A Model for Solving *Hard* Problems

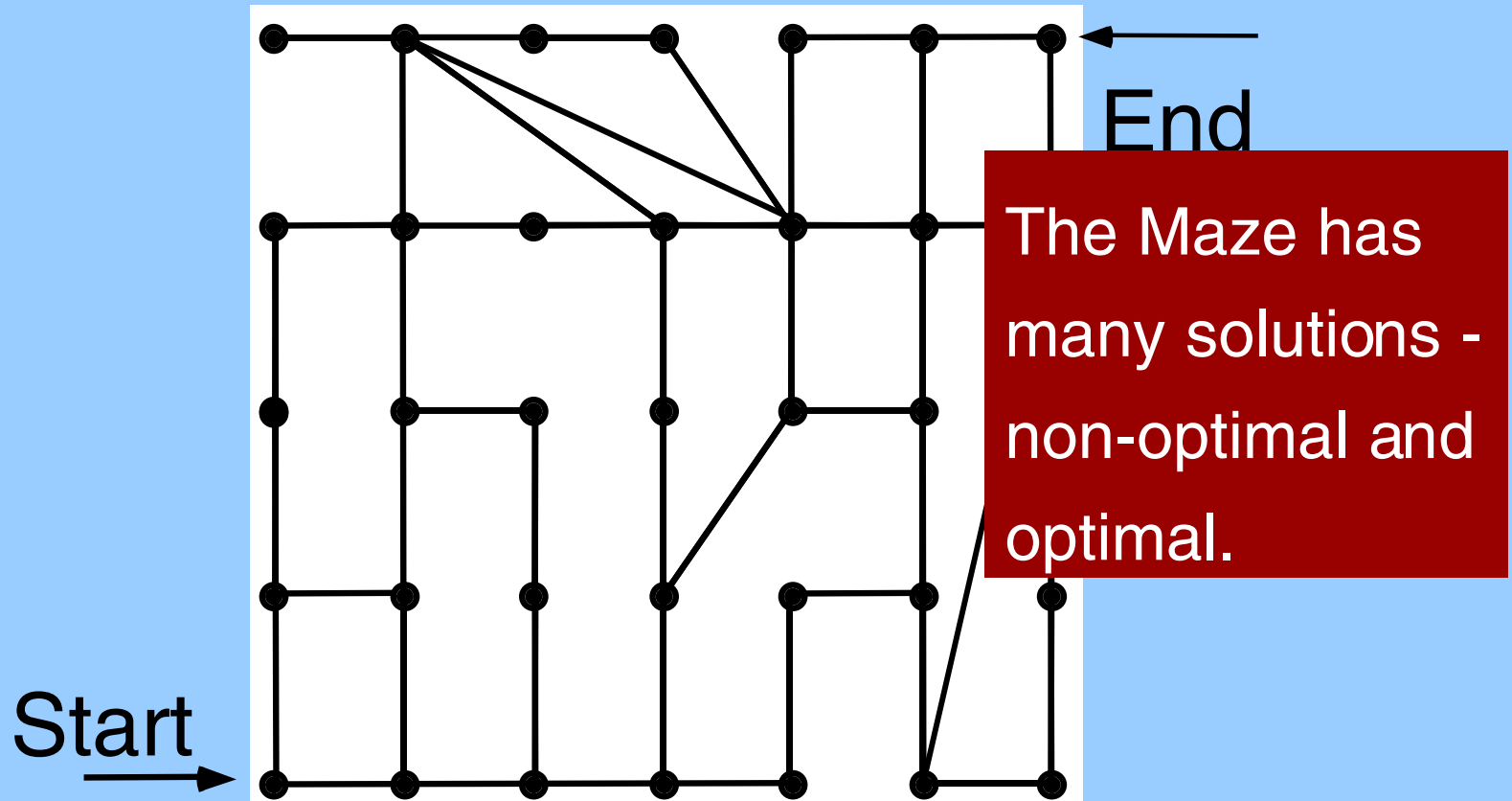


A Model for Solving *Hard* Problems

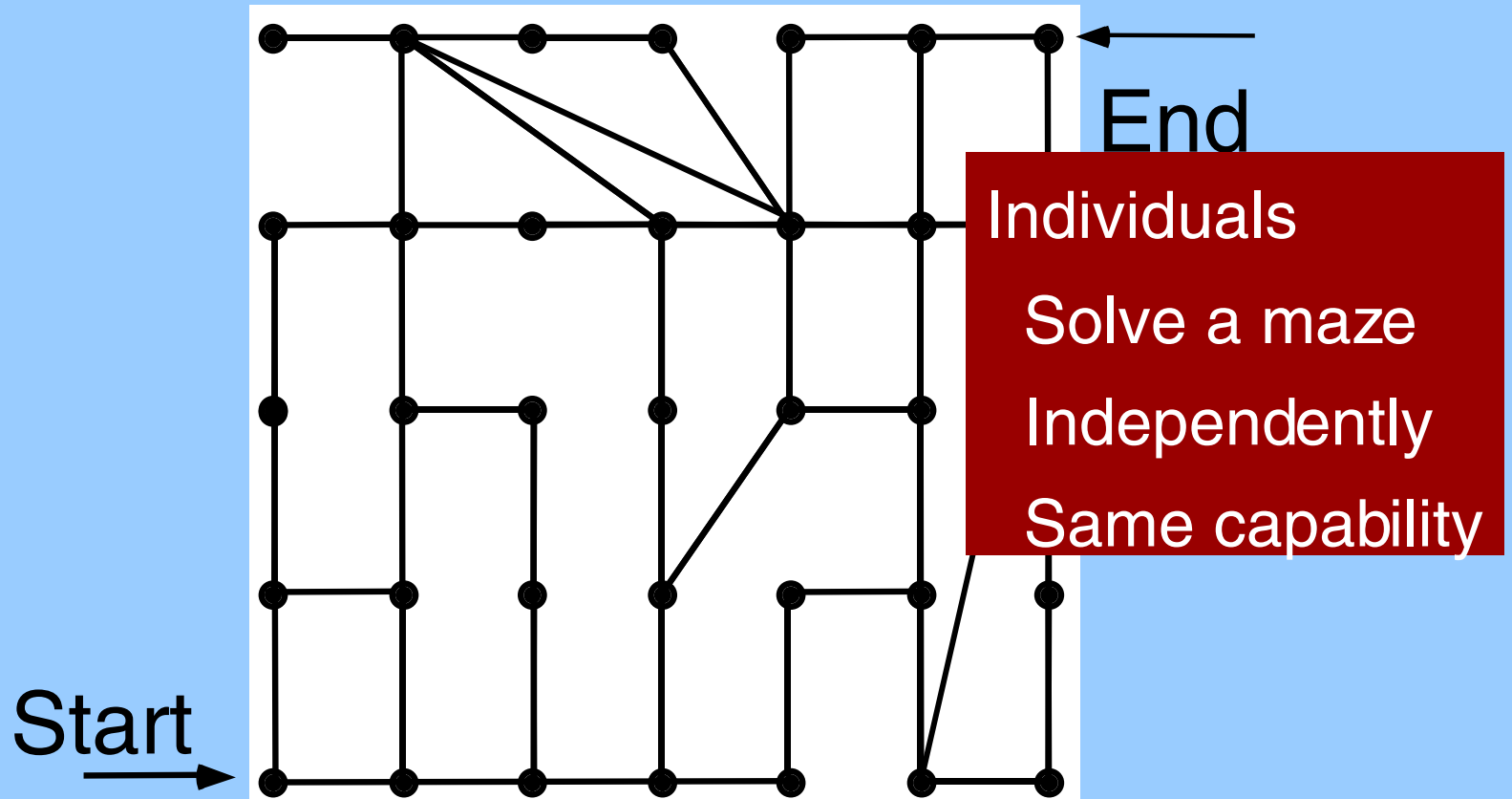
How can groups solve hard problems— without coordination, cooperation, or selection?



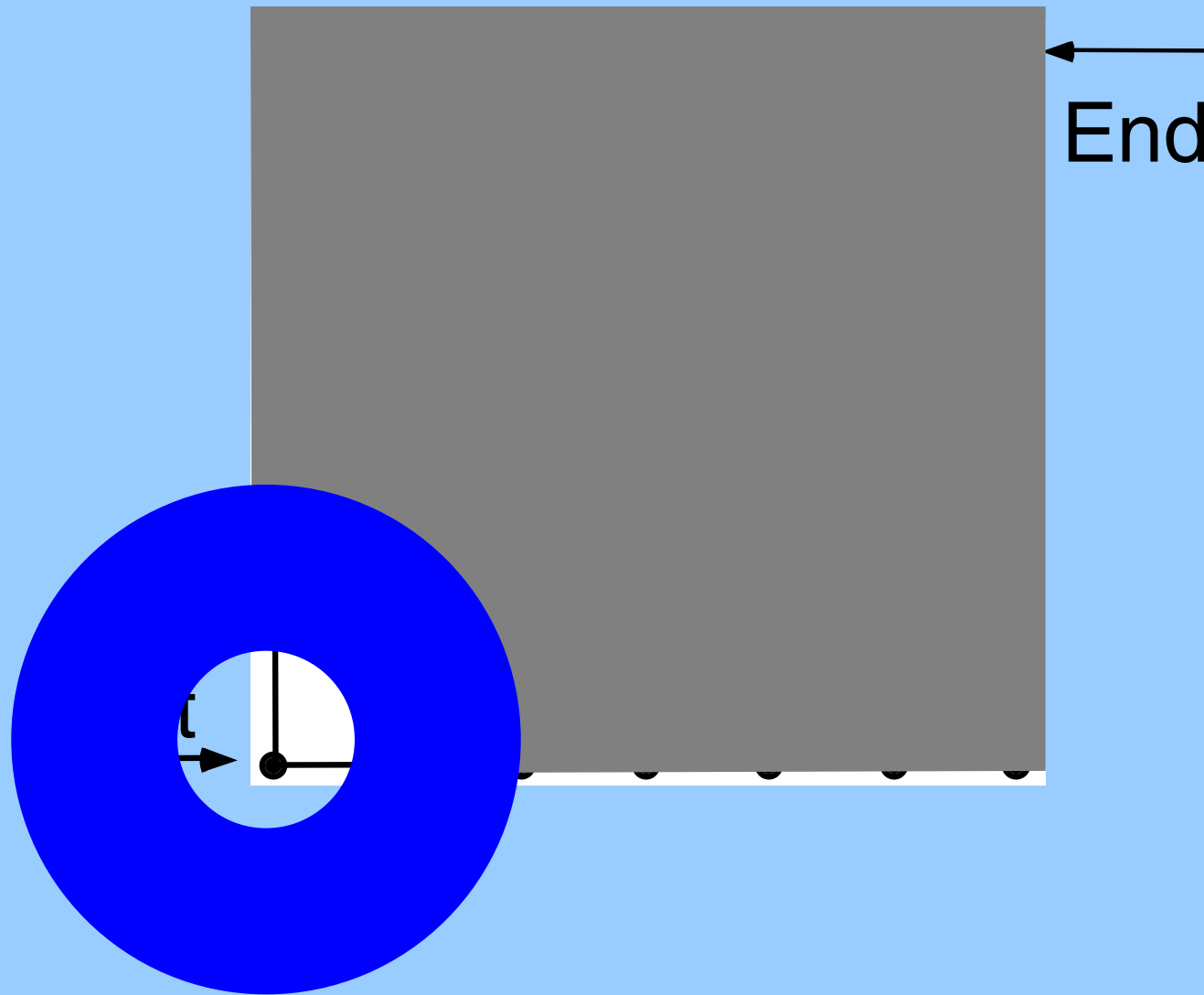
A Model for Solving *Hard* Problems



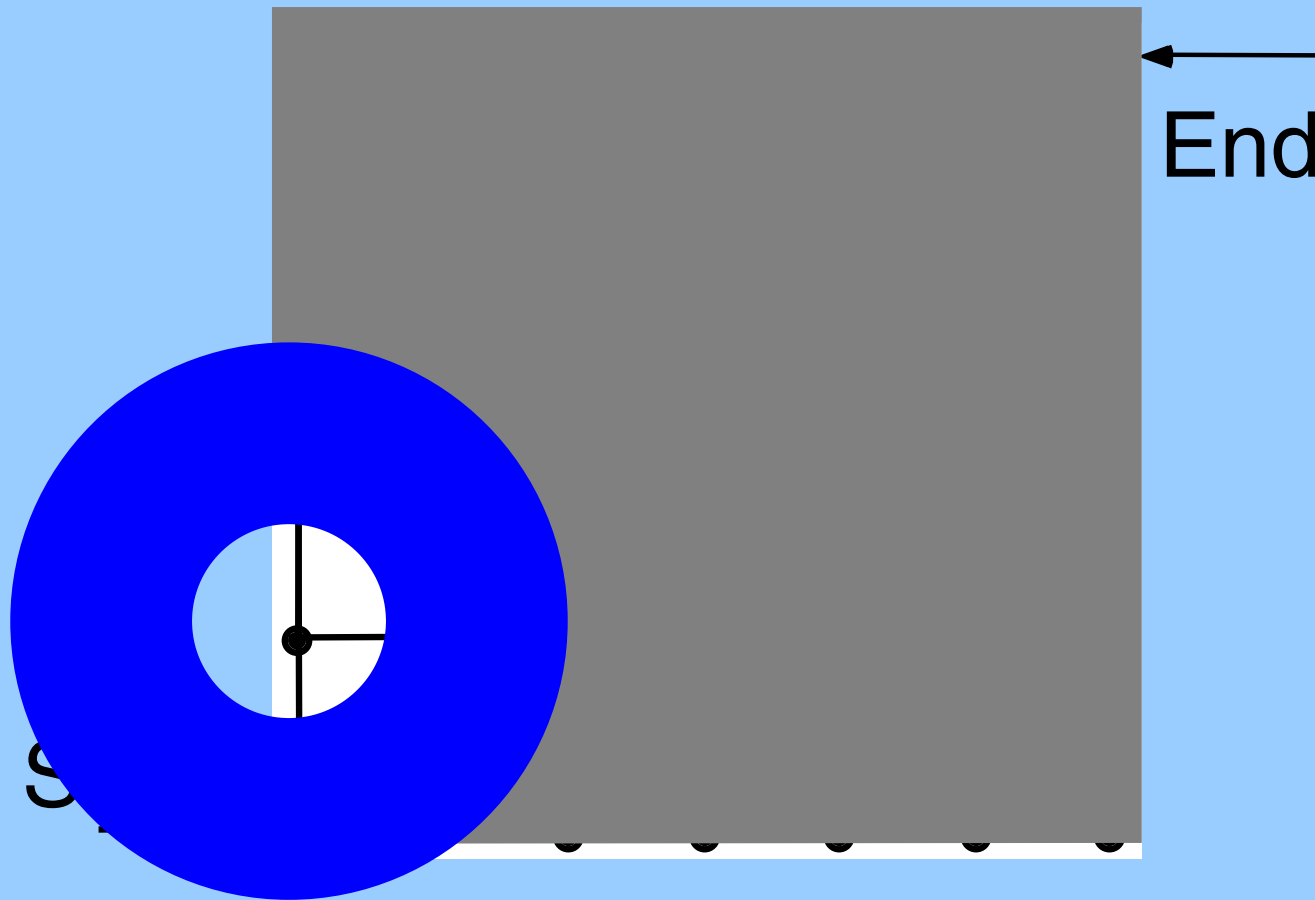
A Model for Solving *Hard* Problems



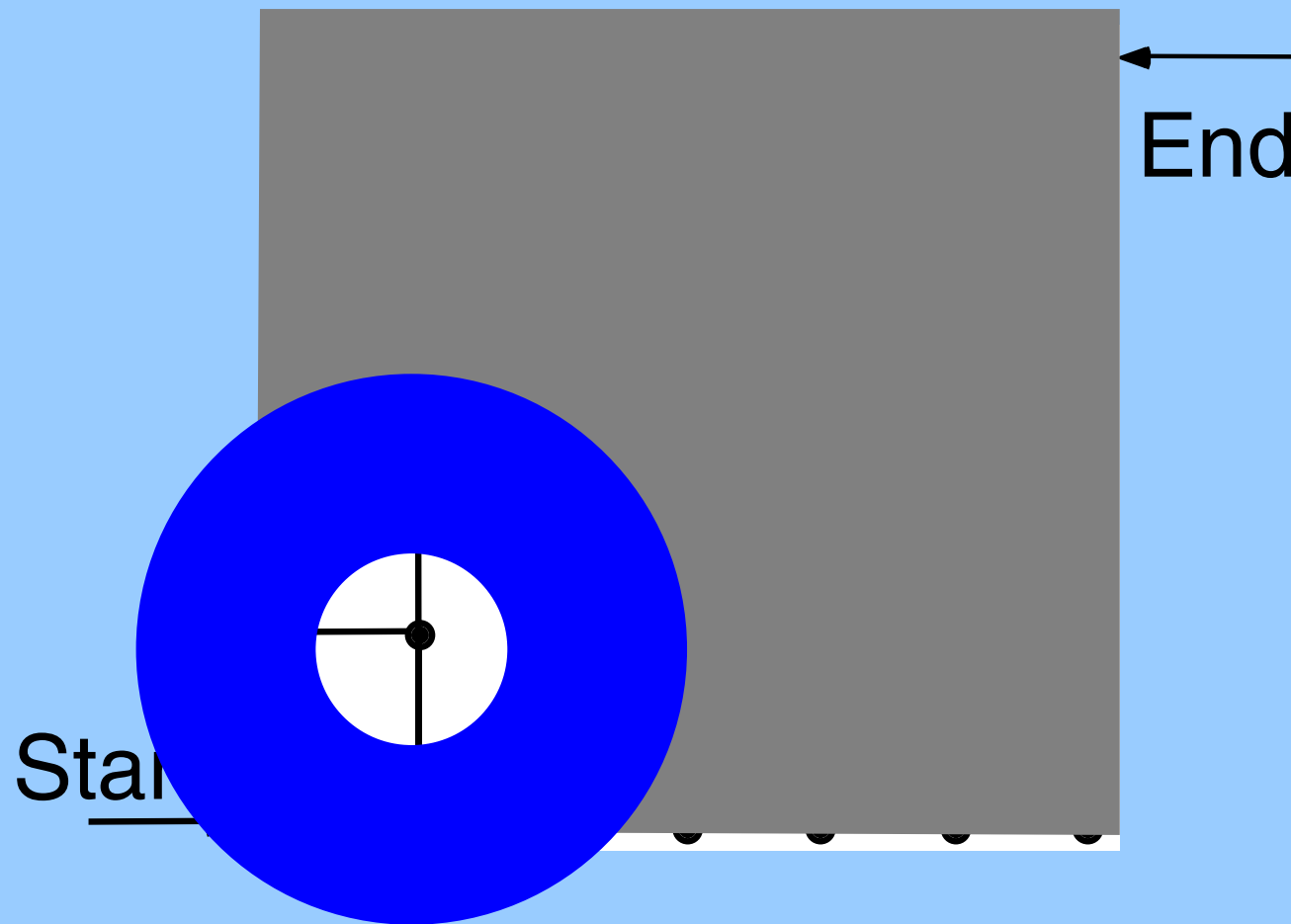
A Model for Solving *Hard* Problems



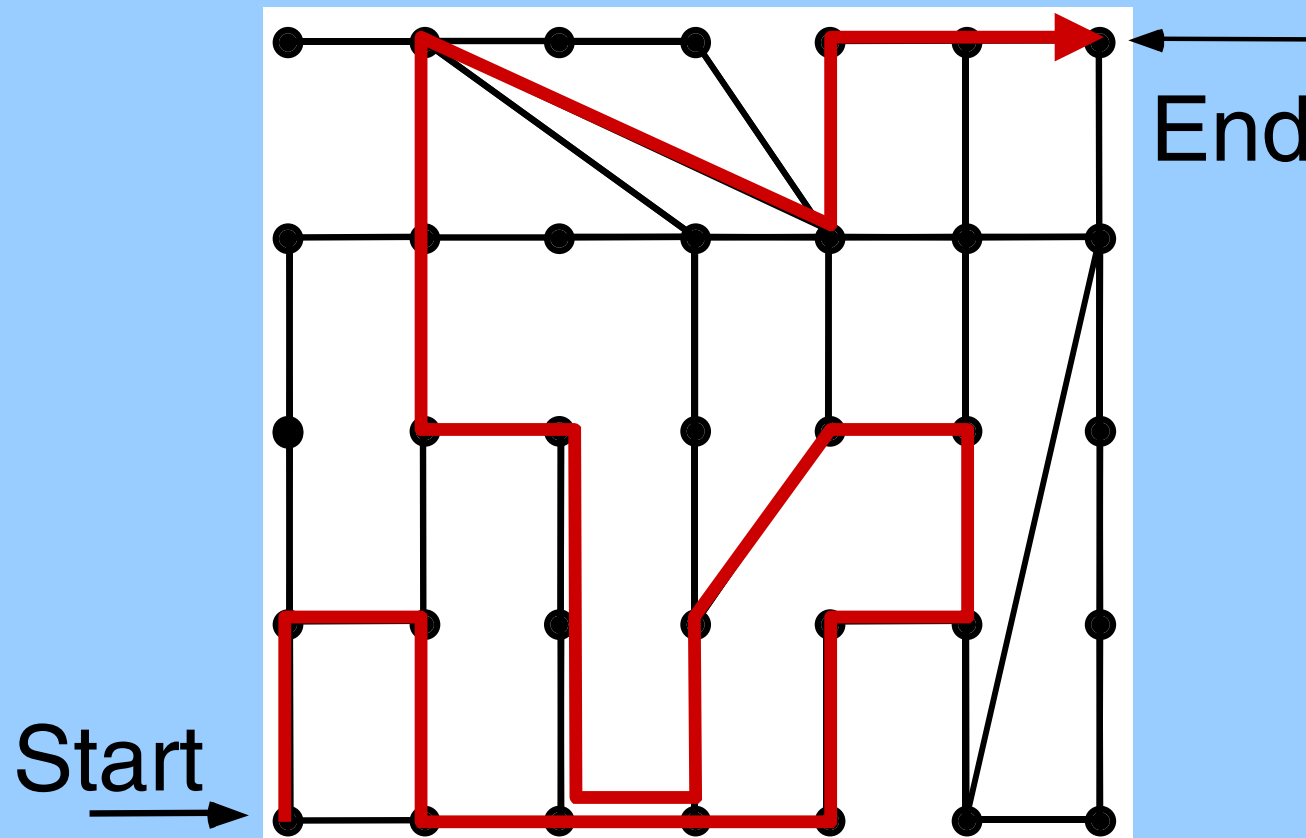
A Model for Solving *Hard* Problems



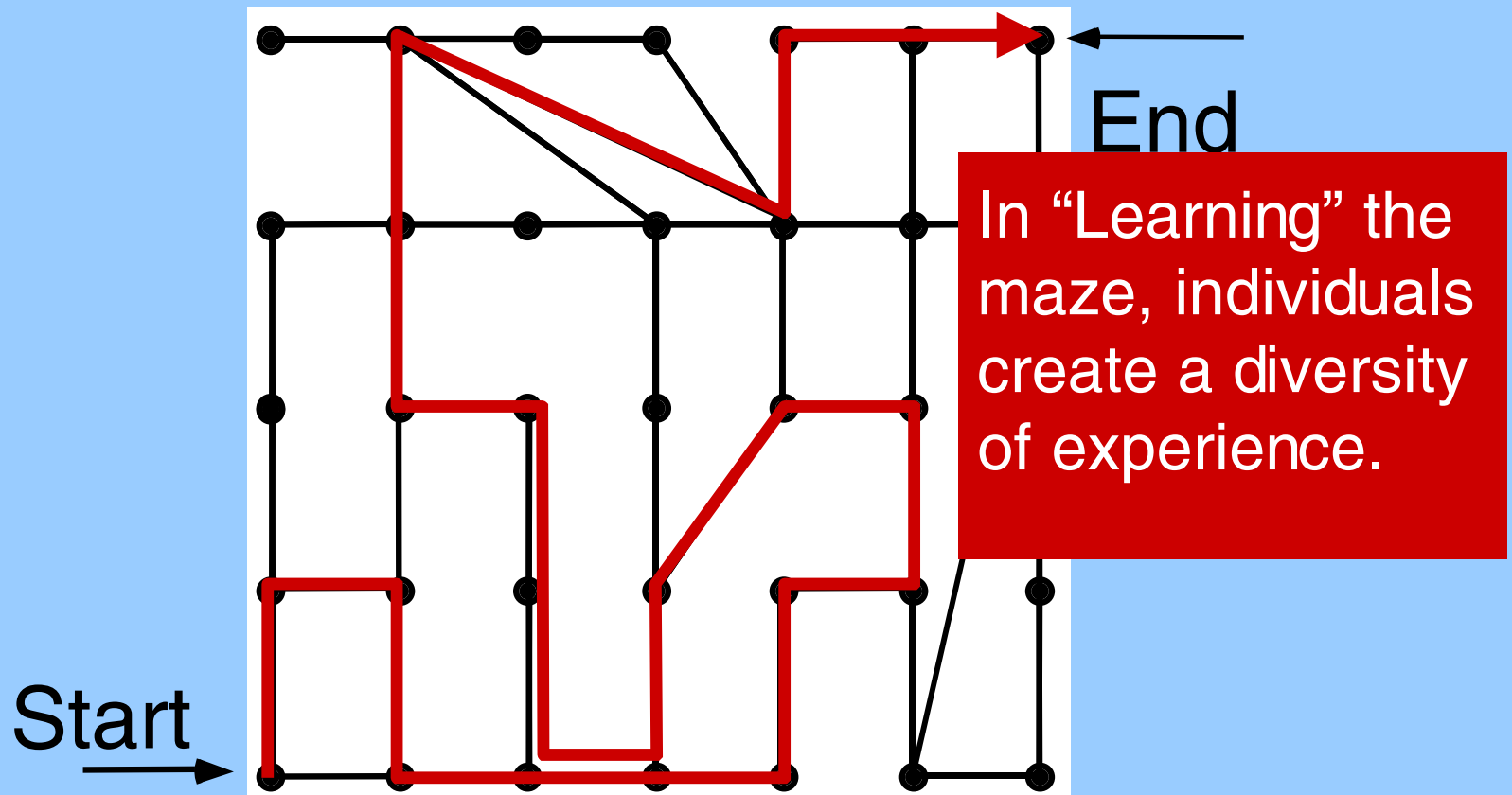
A Model for Solving *Hard* Problems



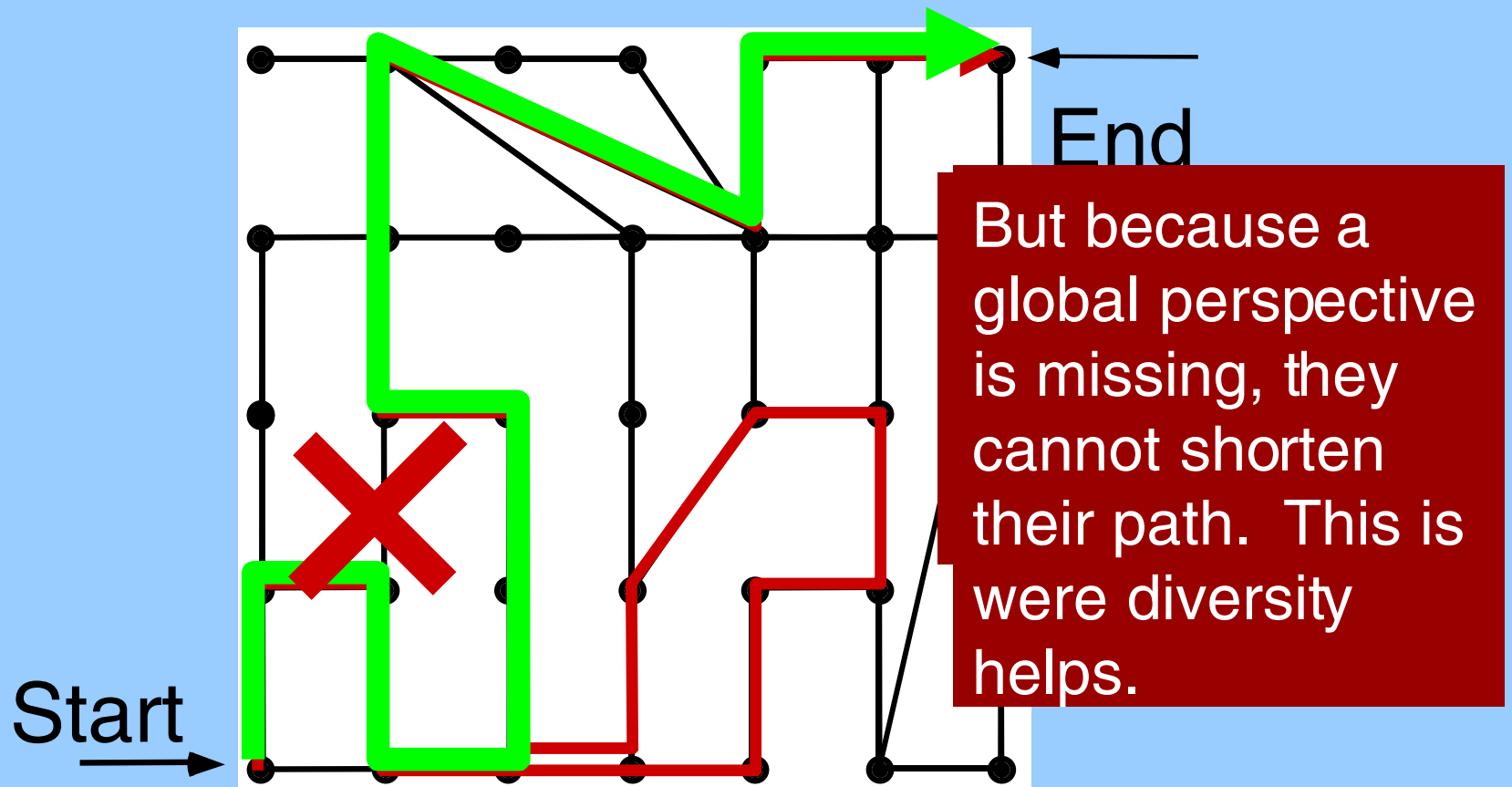
A Model for Solving *Hard* Problems



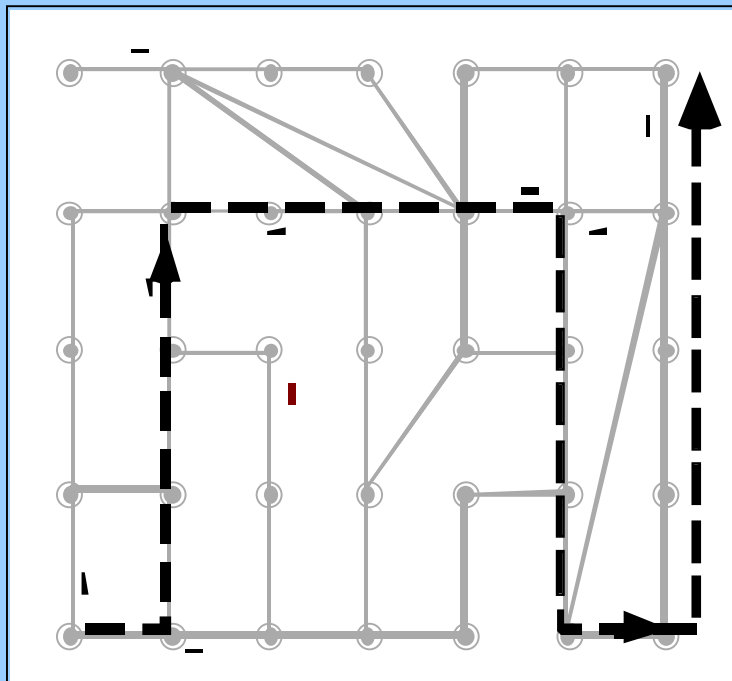
A Model for Solving *Hard* Problems



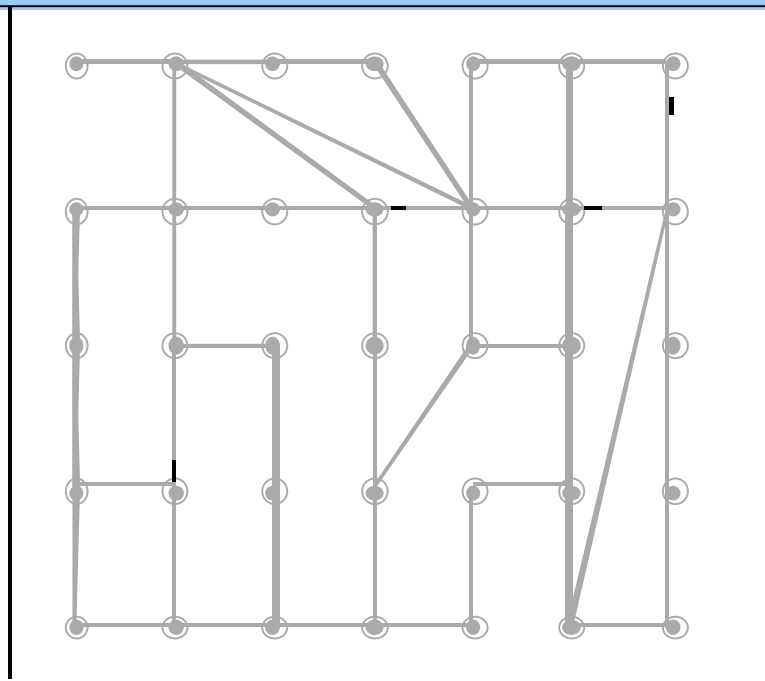
A Model for Solving *Hard* Problems



A Collective Solution

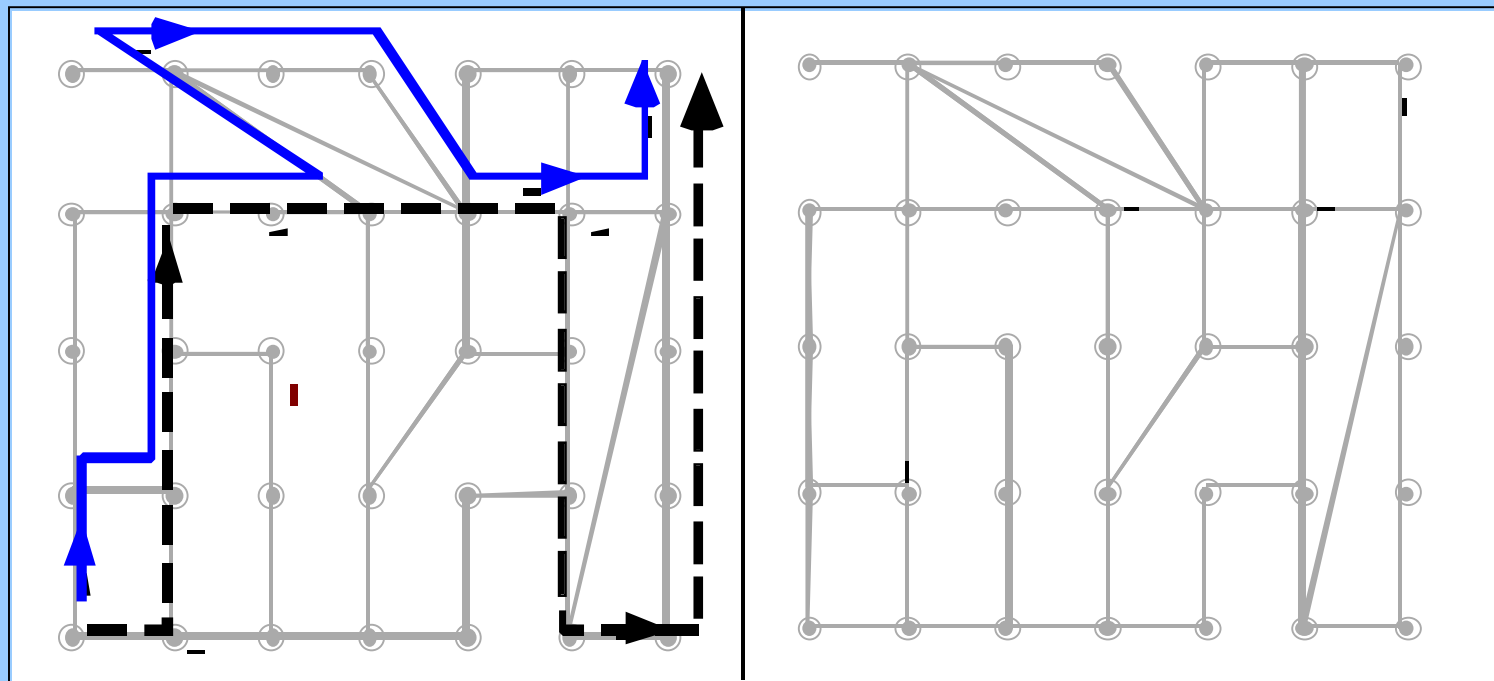


Paths of three individuals



Collective path

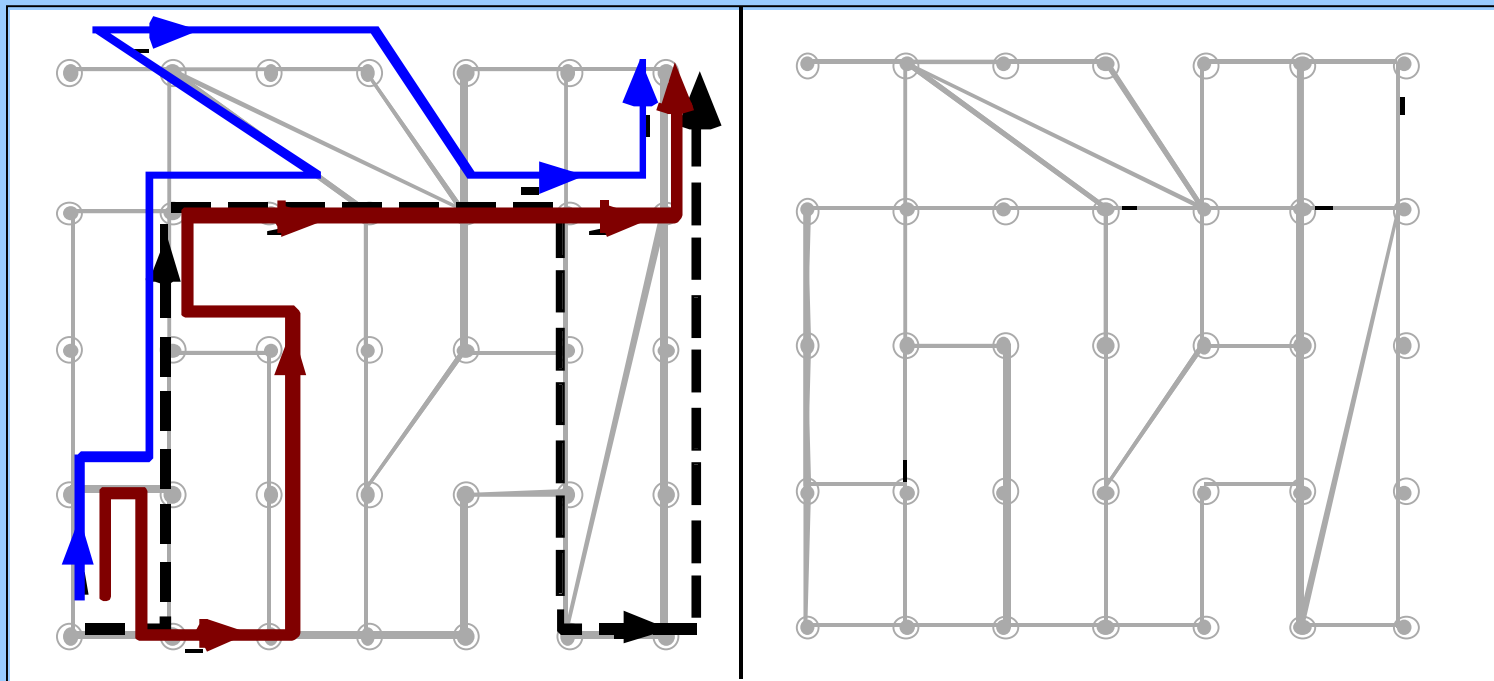
A Collective Solution



Paths of three individuals

Collective path

A Collective Solution

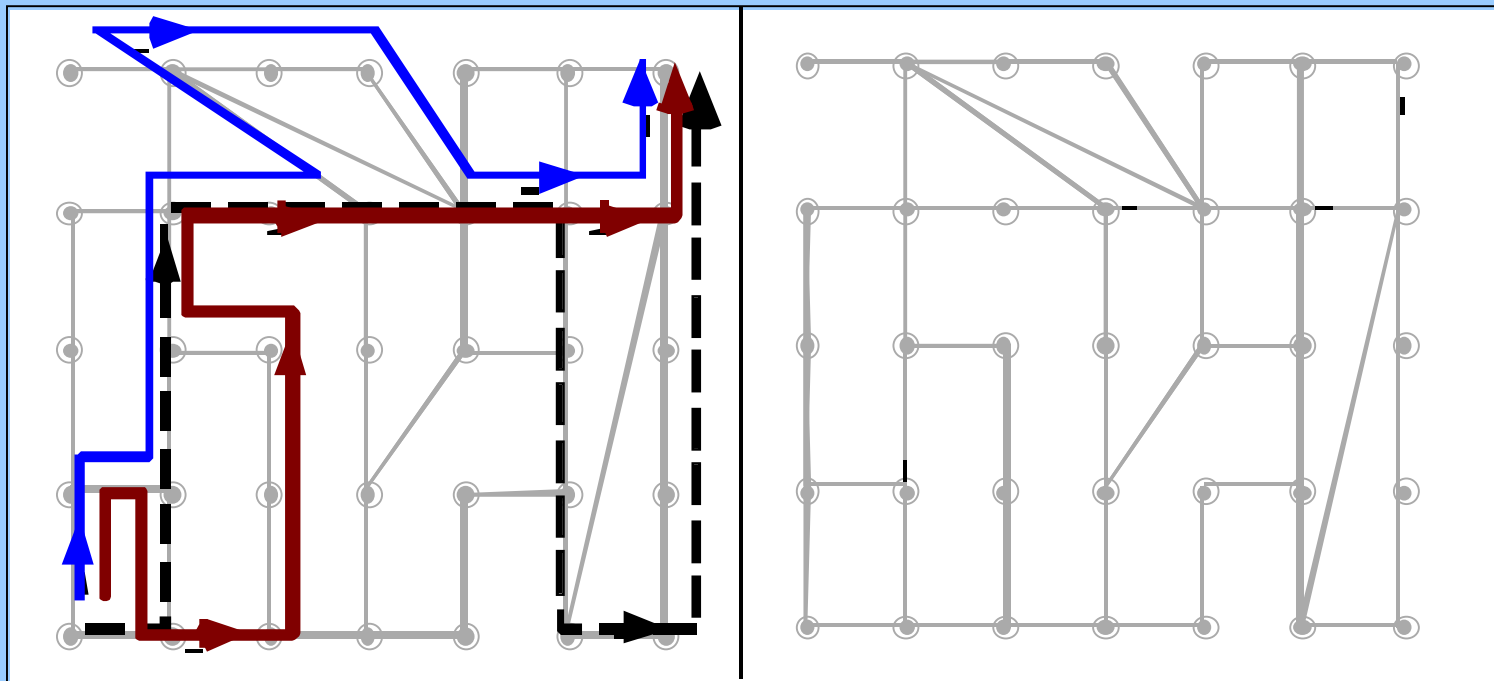


Paths of three individuals

Collective path

A Collective Solution

Combine to form a collective experience.

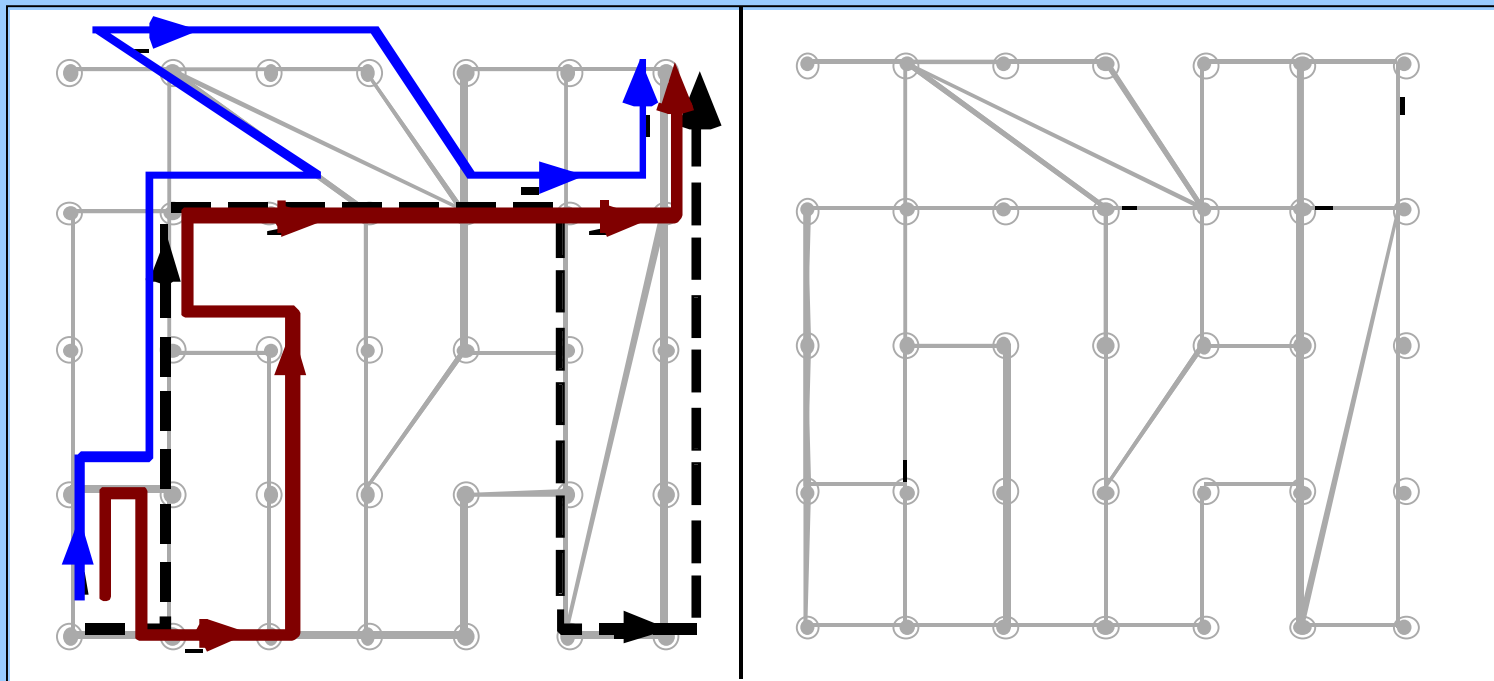


Paths of three individuals

Collective path

A Collective Solution

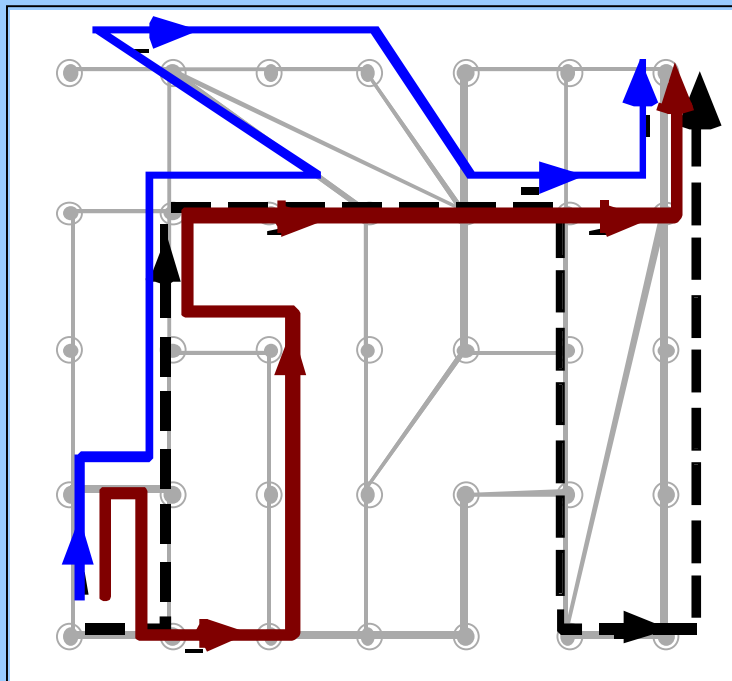
Solve the maze again *using the same individual capability*



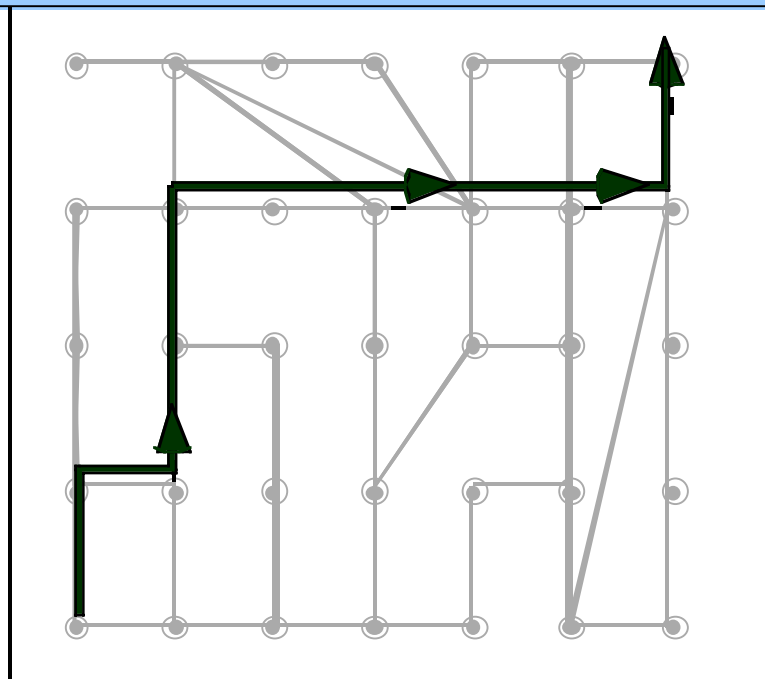
Paths of three individuals

Collective path

A Collective Solution

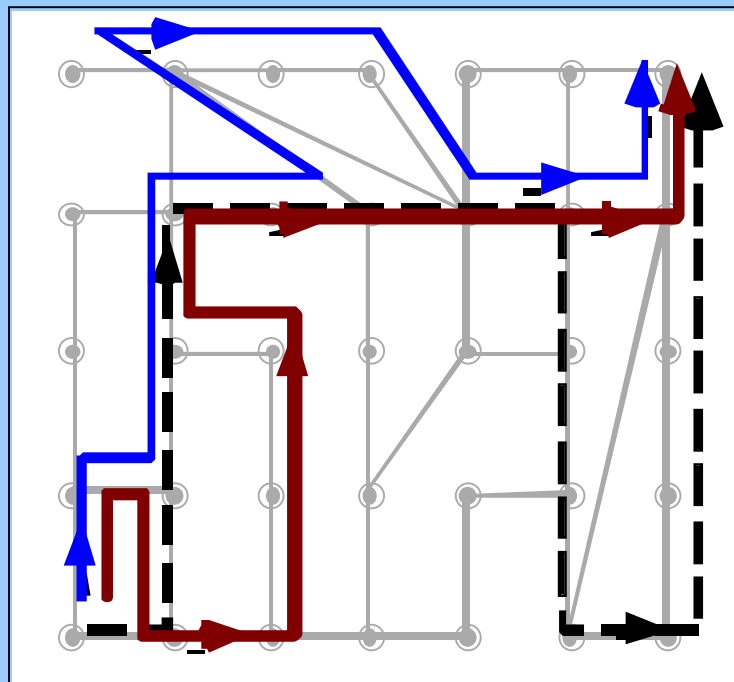


Paths of three individuals

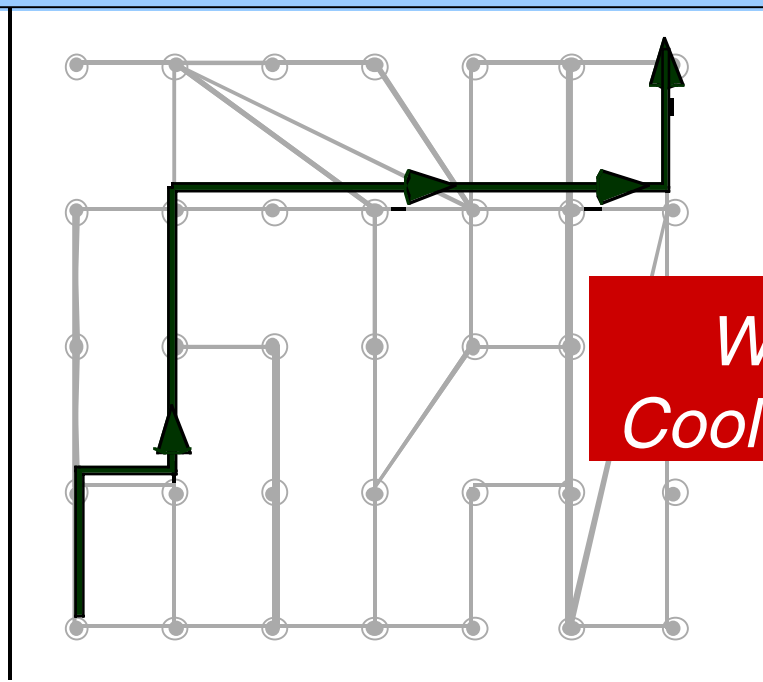


Collective path

A Collective Solution



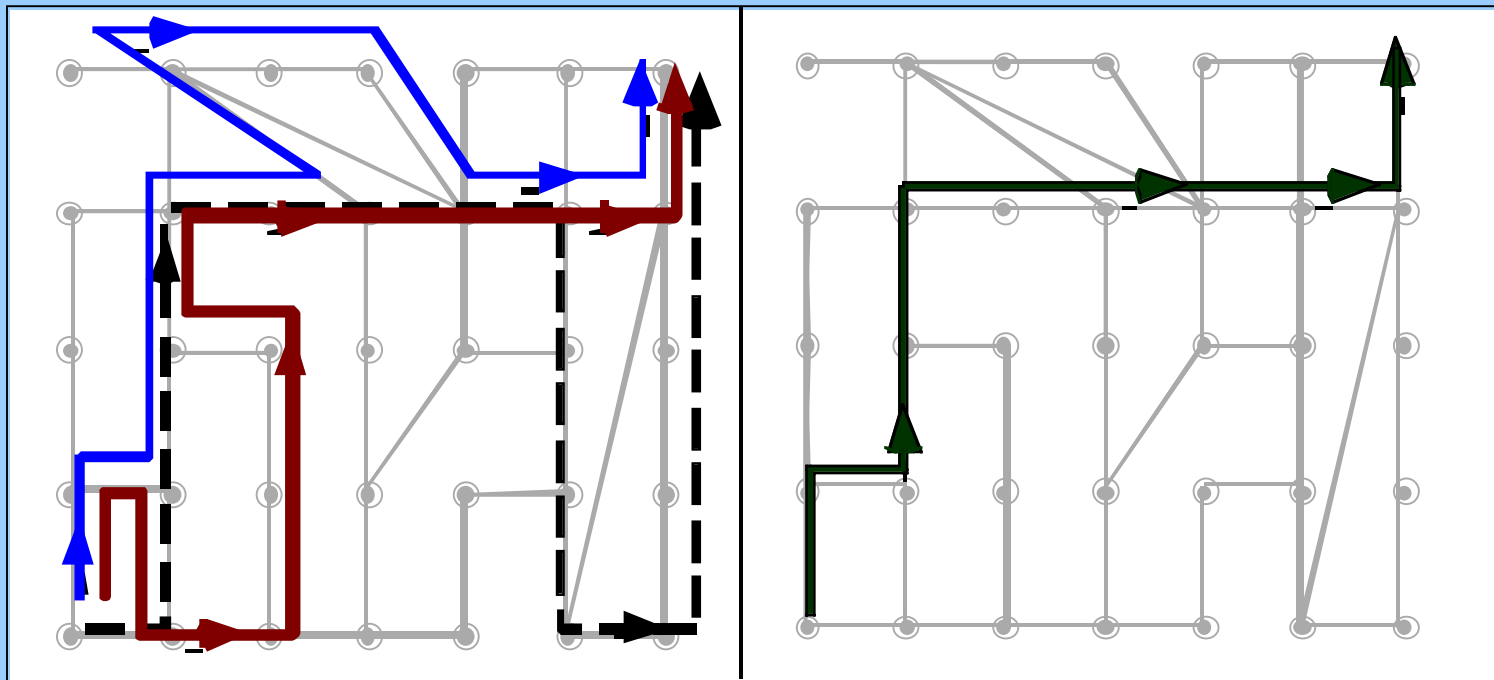
Paths of three individuals



Collective path

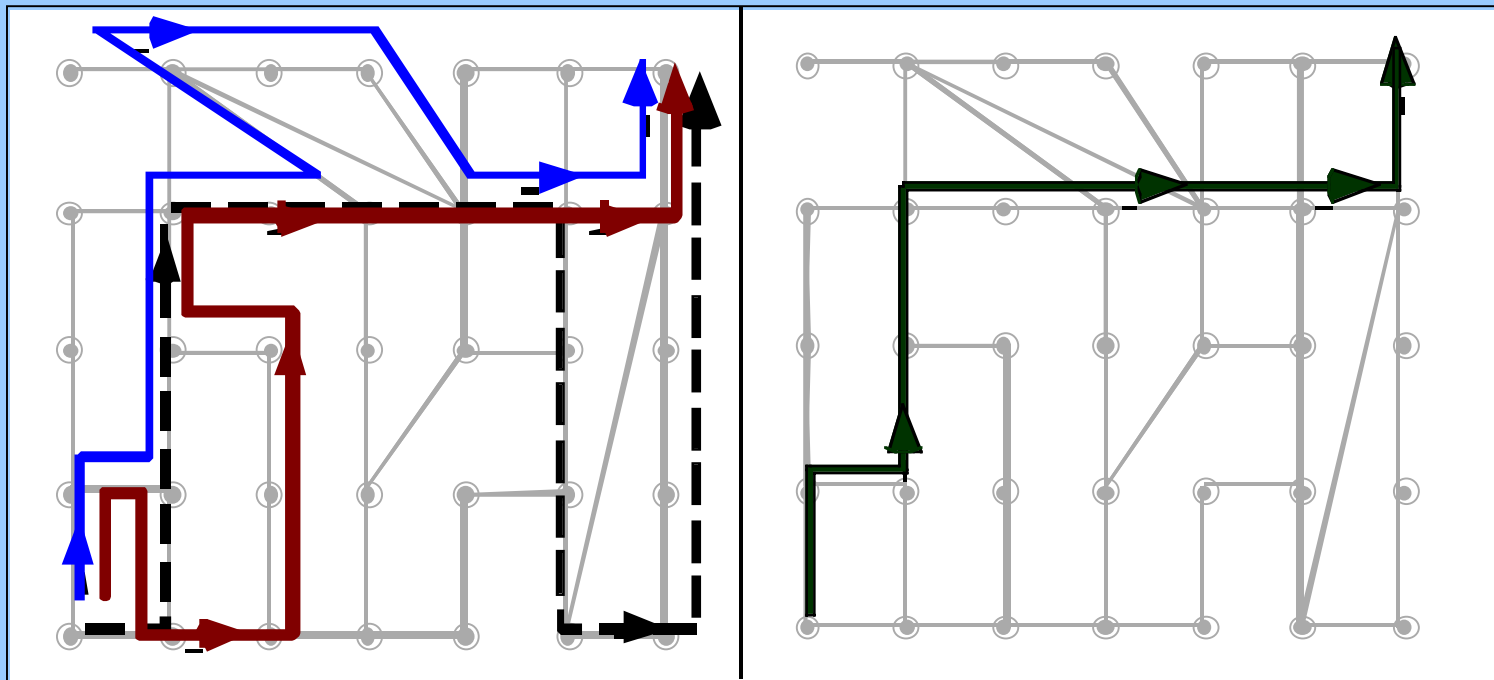
Water-Cooler effect

A Collective Solution



Large collectives of individuals find the minimum path

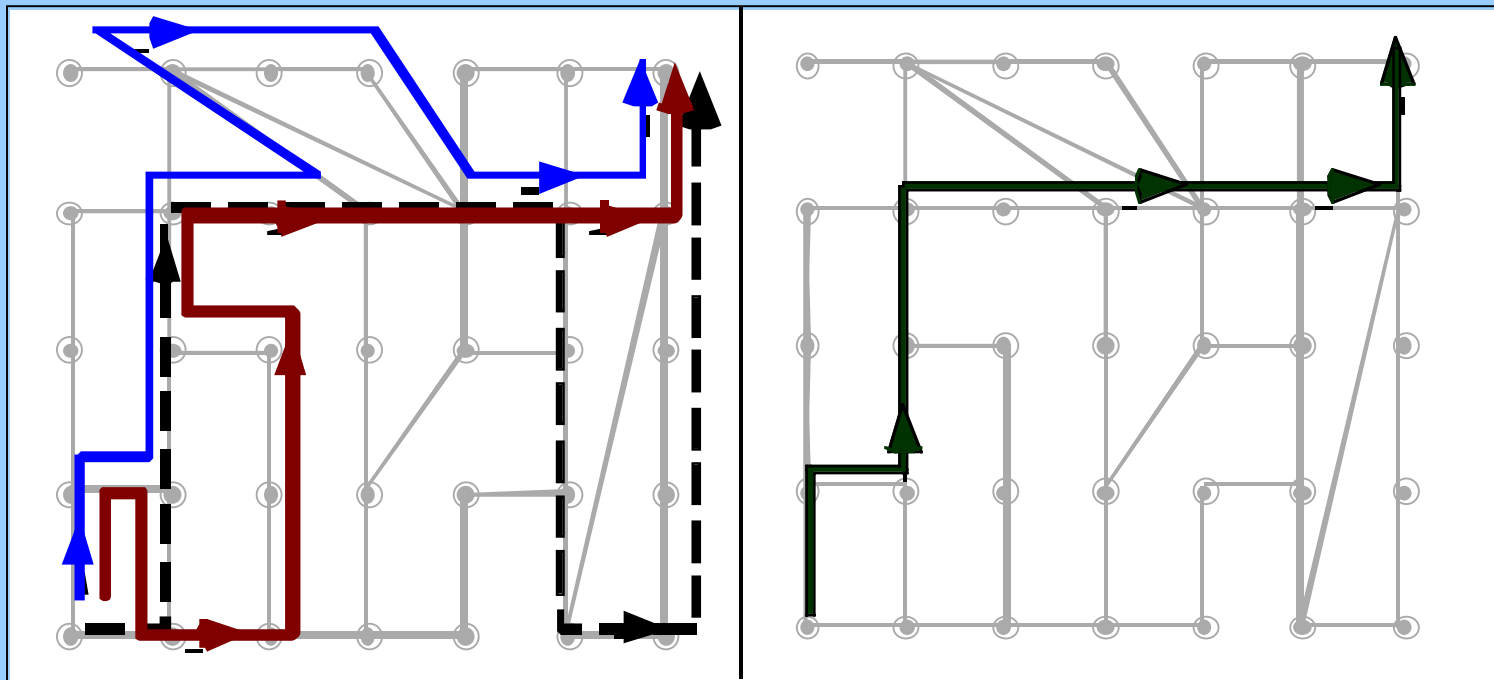
A Collective Solution



Large collectives of individuals find the minimum path
and this performance correlates with diversity:

The unique contributions of individuals to a group

A Collective Solution

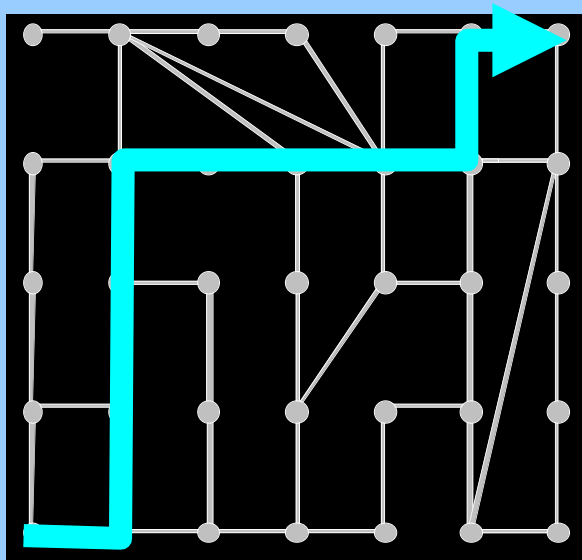


Large collectives of individuals find the minimum path
and this performance correlates with diversity.
Not from selection of individual performance or capability!

Diversity and Robustness

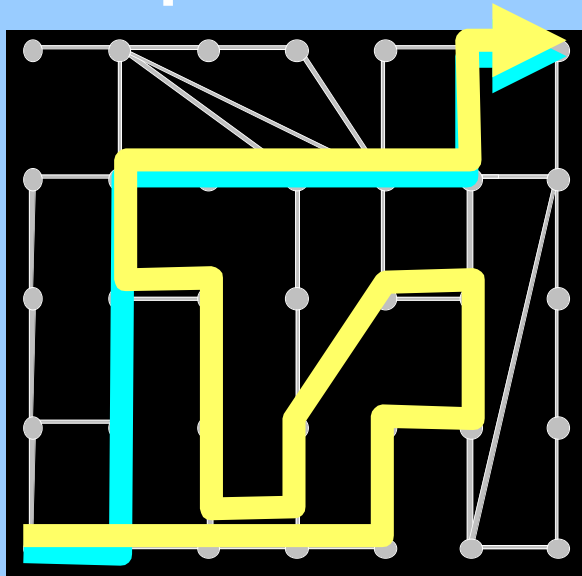
Noise: Replace “valid” information with “false” information

An “expert” individual



Diversity and Robustness

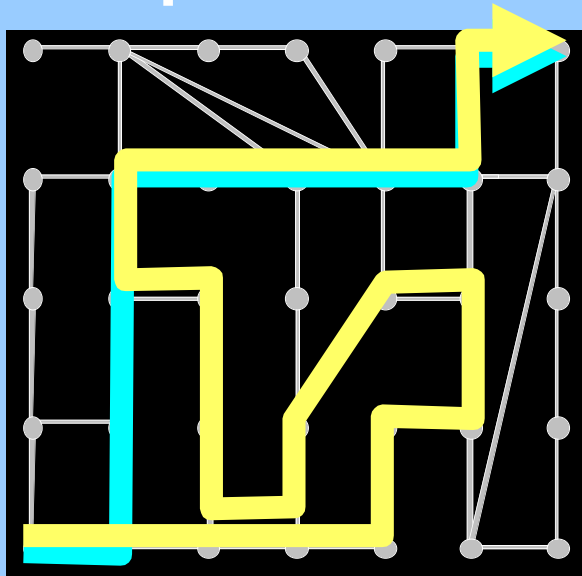
An “expert” individual



Diversity and Robustness

Noise: Replace “valid” information with “false” information

An “expert” individual



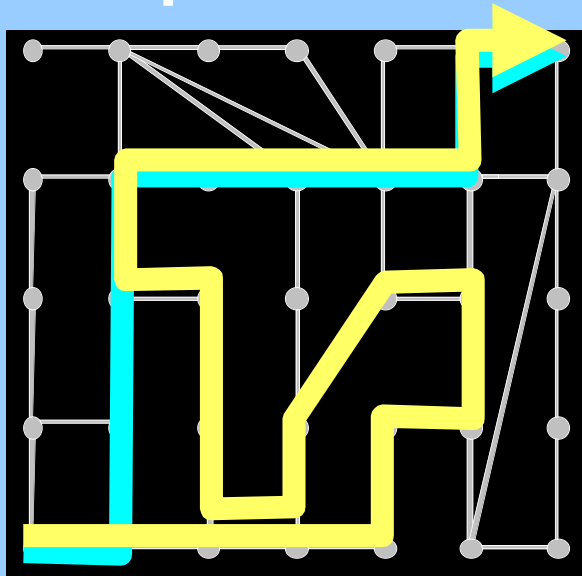
- Individuals are very sensitive to noise

10 steps become 21 steps

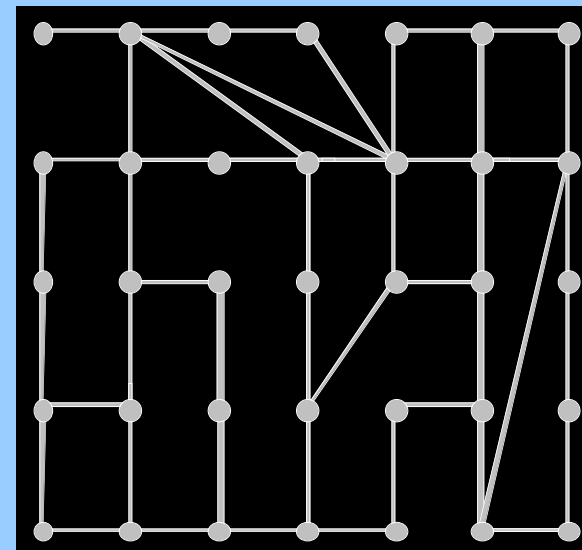
Lack of experience

Diversity and Robustness

An “expert” individual



A collective



- Individuals are very sensitive to noise

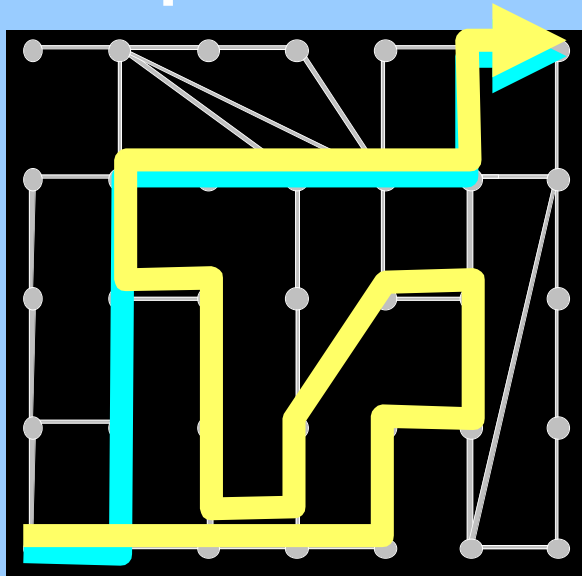
10 steps become 21 steps

Lack of experience

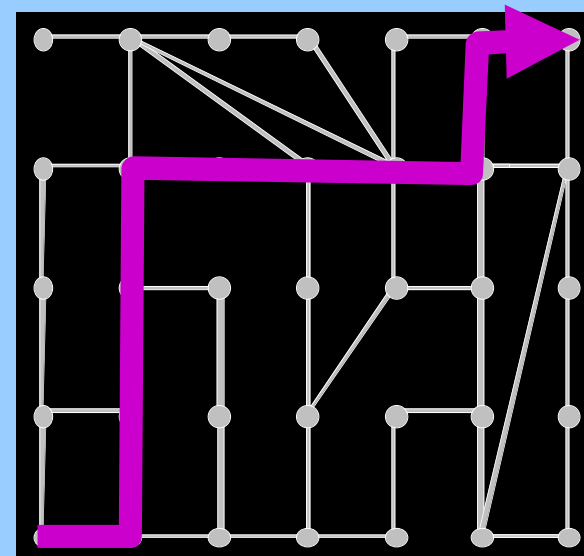
Diversity and Robustness

Noise: Replace “valid” information with “false” information

An “expert” individual



A collective



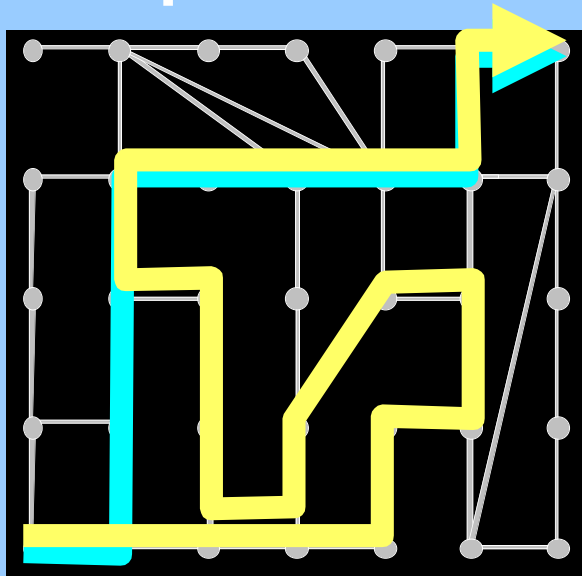
- Individuals are very sensitive to noise

10 steps become 21 steps

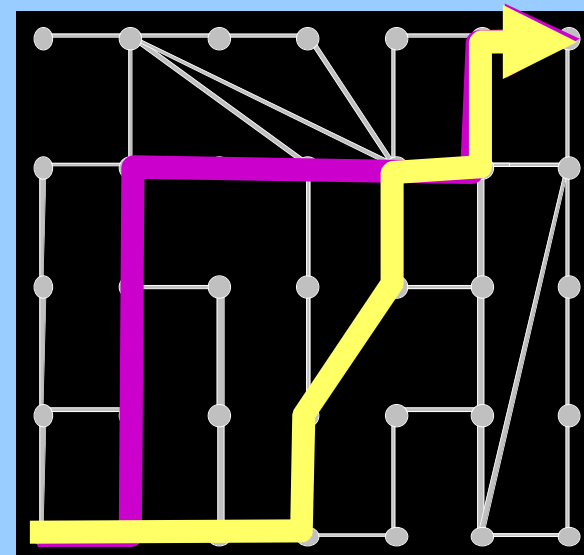
Lack of experience

Diversity and Robustness

An “expert” individual



A collective



- Individuals are very sensitive to noise

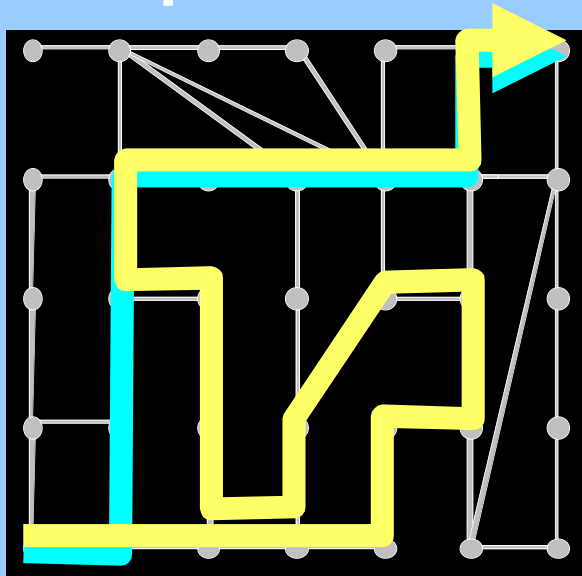
10 steps become 21 steps

Lack of experience

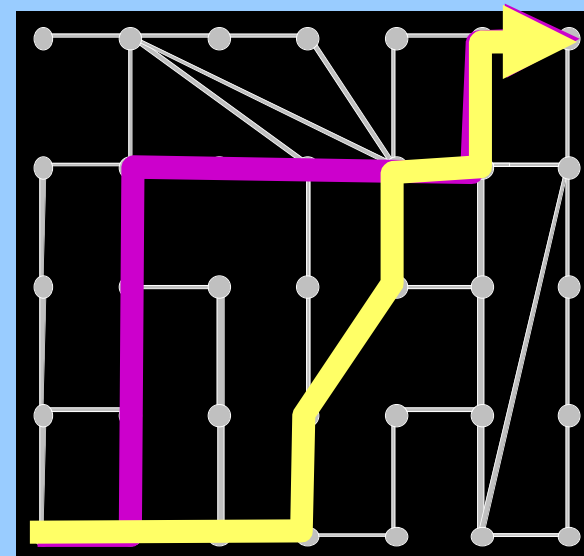
Diversity and Robustness

Noise: Replace “valid” information with “false” information

An “expert” individual



A collective



- Individuals are very sensitive to noise

10 steps become 21 steps

Lack of experience

- Collectives are insensitive

10 steps become 9 steps

Contingency from diversity

Los Alamos

Development of Cooperation

Diversity leads to Collective Benefits

Individual and global improvement without selection
System-wide robustness

Natural Selection

Diversity leads to “low” global performance

Development of Cooperation

Diversity leads to Collective Benefits

Individual and global improvement without selection
System-wide robustness

Higher individual performance → less selection → higher diversity

Natural Selection

Diversity leads to “low” global performance

Development of Cooperation

Development of Exclusive Cooperation

Loss of global robustness

Diversity leads to Collective Benefits

Individual and global improvement without selection
System-wide robustness

Higher individual performance → less selection → higher diversity

Natural Selection

Diversity leads to “low” global performance

Development of Cooperation

Development of Exclusive Cooperation

Loss of global robustness

Stable environment → Flexible interactions become fixed

Diversity leads to Collective Benefits

Individual and global improvement without selection
System-wide robustness

Higher individual performance → less selection → higher diversity

Natural Selection

Diversity leads to “low” global performance

Development of Cooperation

Development of Exclusive Cooperation

Loss of global robustness

System failure

Stable environment → Flexible interactions become fixed

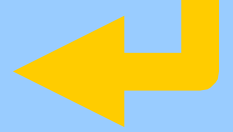
Diversity leads to Collective Benefits

Individual and global improvement without selection
System-wide robustness

Higher individual performance → less selection → higher diversity

Natural Selection

Diversity leads to “low” global performance



The Business Argument

The Business Argument

Informal learning is the source of 70% of our work knowledge

- Two year, \$1.6 million DOL study of Motorola, Boeing, Ford, etc.

The Business Argument

Informal learning is the source of 70% of our work knowledge

- Two year, \$1.6 million DOL study of Motorola, Boeing, Ford, etc.

Why are centralized, formal sources lacking?

- \$100-120 billion a year is spent on formal training programs,
- Yet in complex situations, how is the “best training” determined?

The Business Argument

Informal learning is the source of 70% of our work knowledge

- Two year, \$1.6 million DOL study of Motorola, Boeing, Ford, etc.

Why are centralized, formal sources lacking?

- \$100-120 billion a year is spent on formal training programs,
- Yet in complex situations, how is the “best training” determined?

Why are these informal sources helpful?

- Individual problem solving in a common environment.
- Diversity gives unique perspectives (not about optimal performance).
- Individuals contribute to something much greater than they perceive.

The Business Argument

Informal learning is the source of 70% of our work knowledge

- Two year, \$1.6 million DOL study of Motorola, Boeing, Ford, etc.

Why are centralized, formal sources lacking?

- \$100-120 billion a year is spent on formal training programs,
- Yet in complex situations, how is the “best training” determined?

Why are these informal sources helpful?

- Individual problem solving in a common environment.
- Diversity gives unique perspectives (not about optimal performance).
- Individuals contribute to something much greater than they perceive.

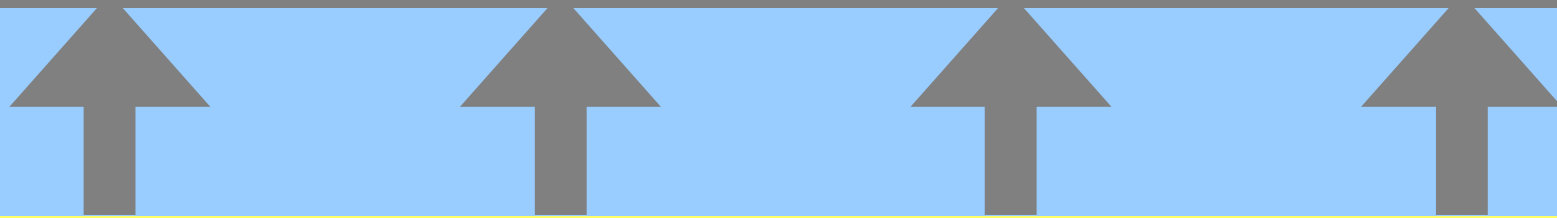
How do we tap the huge collective resources?

- Investment in Enabling Diversity activates Informal Learning.
- Individuals expression, Listen to others, Mixing communities.

Where do you want to be?

Diversity is repressed by Exclusive Cooperation

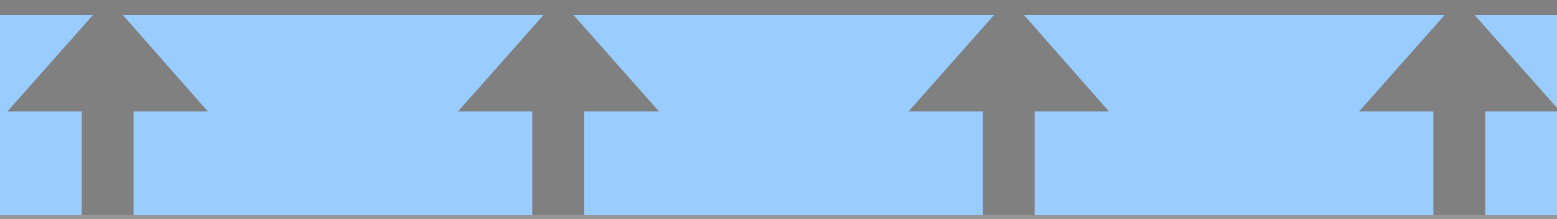
Inflexible interactions – Fragile systems



Diversity leads to

Solution of hard problems by individual “paths”

Robust systems



Diversity leads to Conflict and Competition